YAMAHA

DX27/27S
DX100

DIGITAL PROGRAMMABLE ALGORITHM SYNTHESIZER

SYNTHÉTISEUR NUMÉRIQUE À ALGORITHMES PROGRAMMABLES

DIGITAL PROGRAMMIERBARER ALGORITHMUS SYNTHESIZER

VOICE PROGRAMMING GUIDE
GUIDE DE PROGRAMMATION
ANLEITUNG ZUR INTRUMENTENSTIMMEN-PROGRAMMIERUNG

INTRODUCTION

Once you're thoroughly familiar with the basic operation of the DX27/100, you'll want to begin experimenting with the creation of original FM voices. This is not at all difficult once you "get the feel" of the FM tone generator system. The process, however, is quite different from programming voices on a conventional analog synthesizer. So, to help you get into creating your own voices on the DX27/100 as quickly and as easily as possible, this guide book will provide you with some useful guidelines as well as help you program five new voices:

1. COMBO ORGAN
2. ELECTRIC LUTE
3. BACKING BRASS
4. FM BELLS
5. HARPSI-PIANO

By following the outlined programming procedures and listening to the way each voice sounds at each stage of the programming process, you will develop the "FM awareness" required to program your own voices.

Note that all of these voices will be programmed from scratch (i.e. we will start by initializing a voice using the DX27/100 INIT VOICE function). Once you've mastered programming voices this way, it will be an easy matter to edit existing voices to make slight modifications or create completely new sounds.

Before you actually start working your way through this guidebook, we recommend that you review the VOICE PROGRAMMING chapter—The Basics of FM Synthesis—in the OWNER'S MANUAL.

CONTENTS

BASIC VOICE PROGRAMMING PROCEDURE

In this section, we'll examine the basic steps required for the creation of any voice..Once you get used to programming with FM, you won't need to think about the procedure involved. In the beginning, however, the following discussion will be useful in helping you understand the various elements involved.

1. CHOOSING AN ALGORITHM

This is almost always the first step in programming any voice, since it is the configuration of operators in each algorithm which determines the type of voices that can be produced. The "almost" in the preceding sentence refers to the fact that in some cases you might end up choosing a different algorithm than the one you started with in order to improve the voice. In any case, an algorithm must be selected before you can go any further in the programming process.

The following algorithm/voice type breakdown may serve as a rough guide in choosing a particular algorithm for the type of voice you have in mind. This guide, however, need not be strictly adhered to. Mainly experience will help you find the best algorithms for your own original voices.

ALGORITHMS 1, 2, 3 and 4

These are all single-carrier algorithms, providing the most complex FM modulation. They are best for plucked strings (guitar, harp, bass, harpsichord, etc.), hammered strings (acoustic piano, etc.), reed wind instruments (clarinette, oboe, sax, etc.), woodwinds (flute, piccolo, etc.), and conventional synthesizer type voices. ALGORITHM 3 is a good choice for programming bowed strings (violin, cello, etc.), as well as some horn and brass voices.

ALGORITHM 5

This dual-carrier algorithm has two separate FM modulation "stacks." This lets you create voices with two distinct voice "elements," each having a fairly complex harmonic structure. An example of this type of voice is the electric piano, which has a distinct tine sound (a high "ping" at attack) in addition to the actual piano sound. This algorithm is also useful when creating "thick" voices such as an orchestra and heavy synthesizer voices. It is also good for complex bell voices such as a glockenspiel, tubular bells and a celeste.

ALGORITHM 6

ALGORITHM 6 has three carriers, all modulated at the same time by a single modulator. It is useful for brass, horns, etc.

ALGORITHMS 7 and 8

These have 3 and 4 carriers, respectively. Both of these algorithms are best suited for creating smooth, gentle voices. ALGORITHM 7 does have one FM stack which permits the addition of bright, sharp elements to the voice, while ALGORITHM 8 is made up of all carriers, ideal for organ type voices.

You might find it interesting and educational to go through the preset voices and (in the EDIT mode) look at which algorithms have actually been used for the various voices.

2. SETTING THE CARRIER OUTPUT LEVEL(S)

The initialized output level setting for OP1 is 90. This is sufficient when using ALGORITHMS 1 through 4 since OP1 is their only carrier. With other algorithms, however, it is best to start by setting the output level of all carriers to 90.

3. INITIAL MODULATOR OUTPUT LEVEL SETTING

You will find that for most voices, the modulator output levels between 60 and 75 are the most frequently used. It is best, therefore, to begin programming by setting the output levels of all modulators somewhere within this range.

4. CREATING THE "BASIC" VOICE

It is best to concentrate on programming just one "part" of a voice at a time. For example, if you're working with ALGORITHM 1, turn OFF the 2nd and 3rd modulators (OP3 and OP4), and concentrate on creating the basic voice using just the carrier and 1st modulator. If you choose ALGORITHM 5, start with either of the stacks (OP1 and OP2, or OP3 and OP4) and turn OFF the other two operators. The other operators can be turned back ON later to refine and finish the voice.

5. SETTING THE CARRIER AND 1st MODULATOR FREQUENCY RATIO

In most cases, the carrier frequency ratio in single-carrier algorithms (1 through 4) will be set to 1.00, since this will produce standard keyboard pitch. With multiple-carrier algorithms, however, the carriers may be set at different frequency ratios to create organ-coupler type effects, or voices with two or more distinct frequency components.

The modulator frequency ratio in relation to the carrier frequency determines the timbre of the voice. For example, a carrier/modulator ratio of 1:1 (i.e. carrier = 1.00, modulator = 1.00) produces a sawtooth-like waveform, and a carrier/modulator ratio of 1:2 (i.e. carrier = 1.00, modulator = 2.00) produces a square wave. This is only a general guideline, and the actual results depend on the amount of modulation (modulator output level) applied to the carrier. Fractional ratios (e.g. 1:1.73) can produce extremely complex waveforms that frequently have a "metallic" sound.

You'll have to experiment to find the frequency ratio that produces a timbre which is close to the one you want.

6. INITIAL CARRIER EG SETTING

Now you're ready to set the basic volume envelope ("shape") of the voice. Start with the carrier EG parameters. For more details on the EG parameters refer to the discussion on the Envelope Generators in the "The Basics of FM Synthesis" section of the owner's manual.

7. INITIAL MODULATOR EG SETTING

In many cases, it is sufficient to copy the carrier EG parameters to the modulator using the EG COPY function. This gives a fairly constant timbre over the entire length of the note. If the timbre of the voice is to vary with time, the modulator envelope can then be further modified. The most common form of timbre variation is where the modulator comes in strongly with the attack of the note (producing a rich harmonic structure) and then decays to a lower level as the note is held. This type of timbre variation is common with plucked and hammered strings as well as with brass and horns. The reverse (i.e. modulation gradually increases as the note is held) creates more electronic synthesizer type sounds.

8. FINE MODULATOR OUTPUT LEVEL SETTING

Once the basic EG parameters have been set up, go back and readjust the output level of the modulator to "fine tune" the timbre of the voice. This will probably have to be done at several stages throughout the voice programming process. Whenever you feel the timbre is not quite right, try readjusting the modulator output level.

9. ADDING AND ADJUSTING THE 2nd AND SUBSEQUENT MODULATORS

Once you're satisfied with the basic voice, you can go on and add the remaining elements.

In single-carrier algorithms, turn ON the 2nd modulator and set the appropriate frequency ratio. Then go back and repeat steps 7 and 8 for the 2nd modulator. Add the remaining modulators and repeat. Of course, you don't have to use all the modulators in an algorithm. If you're satisfied with the way things sound with just one carrier and one modulator, then turn the remaining modulators OFF by setting their output levels to 0.

With multiple-carrier algorithms you can add carriers and modulators one at a time, adjusting them as described above.

10. SETTING KEYBOARD SCALING FOR THE BEST OVERALL KEYBOARD BALANCE

Frequently a voice will sound just fine on the lower end of the keyboard, but may become to loud or bright as you play the higher keys. If the voice becomes too loud in the higher keyboard range, apply KEYBOARD LEVEL SCALING to the carrier(s). If the sound becomes too bright or sharp in the upper keyboard range, apply KEYBOARD LEVEL SCALING to the modulators.

Particularly with piano-type voices, the higher notes may sound unnaturally long (the high strings on a real piano decay much faster than the low strings). To shorten the envelope of the higher notes, apply KEYBOARD RATE SCALING to the carrier(s).

11. REFINING THE TOTAL SOUND, ADDING FEEDBACK

With all operators ON, assess the total voice and the EG settings, and adjust if necessary. Feedback may be added at this point. Increasing feedback to a 1st modulator generally adds increasing sharpness, grittiness or bite to the sound. Maximum feedback often results in noise, and can be useful for creating some sound effects. The effects of feedback on the 2nd or 3rd modulators is more subtle.

12. ADDING "LIFE" TO THE VOICE

Your voice is almost completed. To enhance it further, you can now use the DETUNE or LFO effects. The LFO can be used to add vibrato to a voice by setting the PMD (Pitch Modulation Depth) parameter to a value greater than 0. AMD (Amplitude Modulation Depth) can be applied to individual operators, to create a variety of effects. AMD applied to a carrier creates a tremolo effect; applied to a modulator, it can create anything from a wild "wow" sound to a subtle chorus effect.

13. SETTING THE PERFORMANCE PARAMETERS

Set the desired performance controller parameters (Pitch Bend Wheel, Modulation Wheel, Breath Controller) to give you the expressive control you need for the voice.

14. STORE THE COMPLETED VOICE

Use the STORE function (see owner's manual) to store the newly created voice in any one of the INTERNAL voice memory locations.

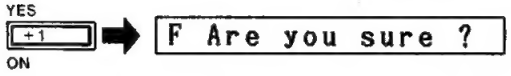
REVIEW: The INIT VOICE Function

Since the voices in the following section will all be programmed starting with the initialized voice parameters, let's quickly review the DX27/100 INIT VOICE function.

1. Press the FUNCTION button to enter the FUNCTION mode.

2. Press the INIT VOICE button. The LCD will respond with "Init voice?".

3. Press the YES button. The LCD will respond with "Are you sure?".



4. Press the YES button again and the initial voice parameters (see chart) will be loaded into the voice edit buffer. The EDIT mode will automatically be entered allowing you to begin programming your voice.

										AME			OP
										0	0	0	4
1	0	triangl	35	0	0	0	off	6	0	0	0	0	3
										0	0	0	2
										0	0	0	1
ALGORITHM	FEEDBACK	WAVE	SPEED	DELAY	PMD	AMD	SYNC	PITCH	AMPLITUDE	EG BIAS	KEY VELOCITY		
		LFO						MODULATION SENSITIVITY					
1	2	3	4	5	6	7	8	9	10	11	12		

OP												
4	1.00	0	31	31	15	0	15	0	0	0		
3	1.00	0	31	31	15	0	15	0	0	0	C3	
2	1.00	0	31	31	15	0	15	0	0	0		
1	1.00	0	31	31	15	0	15	90	0	0		
	FREQ RATIO	DETUNE	AR	D1R	D1L	D2R	RR	OUT LEVEL	RATE	LEVEL	TRANSPOSE	
	OSCILLATOR		ENVELOPE GENERATOR					OPERATOR	KEYBOARD SCALING			
	13	14	15	16	17	18	19	20	21	22	23	24

POLY/MONO	PITCH BEND RANGE	PORTAMENTO		FOOT SW ASSIGN	WHEEL RANGE		BREATH RANGE			
		MODE	TIME		PITCH	AMPLITUDE	PITCH	AMPLITUDE	PITCH BIAS	EG BIAS
Poly	4	Full T. Porta	0	Sus	50	0	0	0	50	0

Note that when a voice is initialized, only operator number 1 (from now on referred to as OP1) is ON. That is, the OP1 output level is set to 90 while all other operators are OFF (set to 0). In all 8 algorithms on the DX27/100, OP1 is a carrier, so if you play a note, all you will hear is a simple sine wave—the output from OP1. Note also that the envelope generators are set to the simplest form of envelope. When playing a key, the sound begins immediately at maximum level; When releasing the key, the sound stops immediately. The operator frequency ratios are all set to their basic value: 1.00 (all operators produce the same frequency). It is important to understand this situation since it is from this most basic "voice" (a simple sine wave) that all our voices will be created.

Now that we have executed the INIT VOICE function and have the initial voice parameters all loaded into the DX27/100's voice edit buffer, let's begin by programming a very simple voice.

SAMPLE VOICES

In this section, we provide the data for five new FM voices that you can program yourself. After having done this, you should be familiar enough with the workings of the FM system to go on programming even better voices that are ideal for your own musical applications.

For the first and most simple voice—COMBO ORGAN—we will provide complete step-by-step programming instructions. For the remaining four voices, however, we'll give you a data chart with a few pointers and let you do the actual programming on your own.

If you get stuck, refer back to the BASIC VOICE PROGRAMMING PROCEDURE section for help.

VOICE 1: COMBO ORGAN

For our COMBO ORGAN voice we will use ALGORITHM 8. As you can see by looking at the ALG8 diagram, there are no modulator-carrier relationships, so no true FM modulation can take place. All the operators act as carriers, so basically, we will simply be adding the outputs of the four operators together. We will, however, take advantage of the feedback loop provided on OP4, allowing OP4 to modulate itself to produce a nice gritty sound as one of the voice "elements" we will use to create the total organ sound.

Here is the filled-in DATA MEMO chart for the COMBO ORGAN voice (a blank chart is provided in the back of this manual and the DX27/100 owner's manual; make copies of it and use it to record your own voice parameters).

DATA NAME : COMBO ORGAN

DATE :

NUMBER :

PROGRAMMER :

										AME			OP
8	7	triangl	30	32	10	0	off	6	0	0	0	0	4
										0	0	0	3
										0	0	0	2
										0	0	0	1
ALGORITHM	FEEDBACK	WAVE	SPEED	DELAY	PMD	AMD	SYNC	PITCH	AMPLITUDE	EG BIAS	KEY VELOCITY		
		LFO						MODULATION SENSITIVITY					
1	2	3	4	5	6	7	8	9	10	11	12		

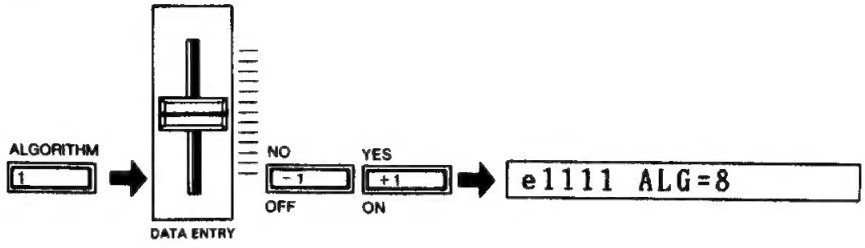
OP												
4	6.00	0	31	13	12	0	15	90	0	30	C3	
3	2.00	0	31	31	15	0	15	90	0	0		
2	1.00	0	31	31	15	0	15	90	0	0		
1	0.50	0	31	31	15	0	15	90	0	0		
	FREQ RATIO	DETUNE	AR	D1R	D1L	D2R	RR	OUT LEVEL	RATE	LEVEL	TRANSPOSE	
	OSCILLATOR		ENVELOPE GENERATOR					OPERATOR	KEYBOARD SCALING			
	13	14	15	16	17	18	19	20	21	22	23	24

POLY/MONO	PITCH BEND RANGE	PORTAMENTO MODE	PORTAMENTO TIME	FOOT SW ASSIGN	WHEEL RANGE PITCH	WHEEL RANGE AMPLITUDE	BREATH RANGE PITCH	BREATH RANGE AMPLITUDE	BREATH RANGE PITCH BIAS	BREATH RANGE EG BIAS
Poly	4	Full T. Porta	0	Sus	50	0	0	0	50	0

If you feel confident in your programming ability, go ahead and set the parameters given. If you need a little more coaching, follow the step-by-step programming instructions below.

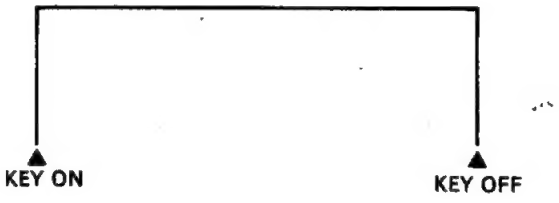
STEP 1: SELECT THE ALGORITHM

Press the ALGORITHM button and then use the DATA ENTRY slider or buttons to select ALGORITHM 8.



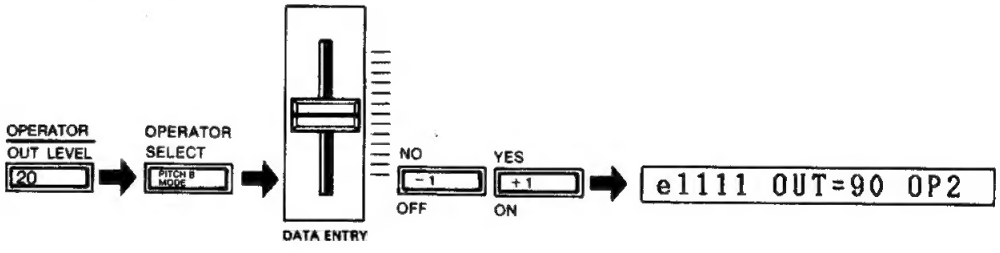
STEP 2: SET THE BASIC VOLUME ENVELOPE

In this case, we'll leave the EG parameters at their initial values since the COMBO ORGAN voice requires a simple ON/OFF type of volume envelope. Here's what the envelope looks like in graphic form:

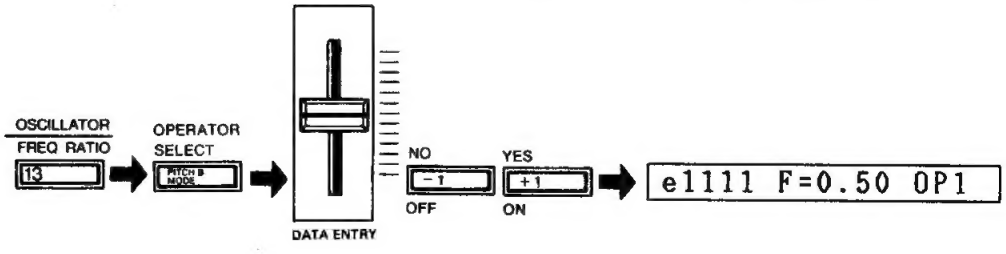


STEP 3: ADD THE OPERATORS, SET THE FREQUENCY RATIOS AND SET THE BASIC OUTPUT LEVELS

a. Press the OPERATOR OUT LEVEL button and set the output levels of OP2, OP3 and OP4 to 90.

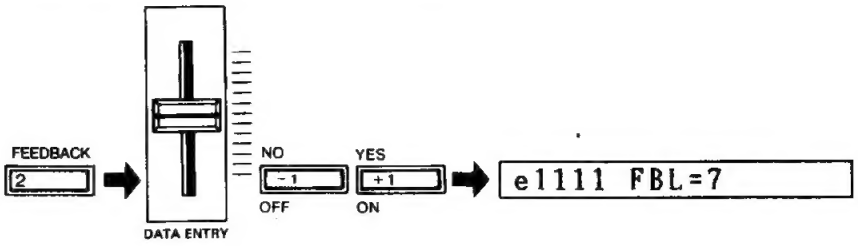


b. Press the OSCILLATOR FREQ RATIO button and set the frequency ratio of OP1 to 0.50, OP2 to 1.00 (initial setting), OP3 to 2.00, and OP4 to 6.00.



STEP 4: ADD FEEDBACK

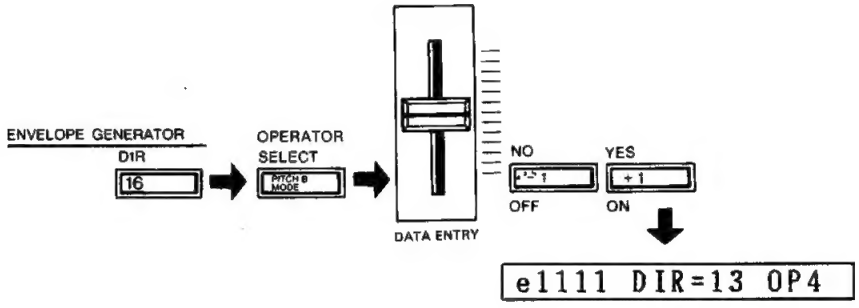
Press the FEEDBACK button and set it to 7.



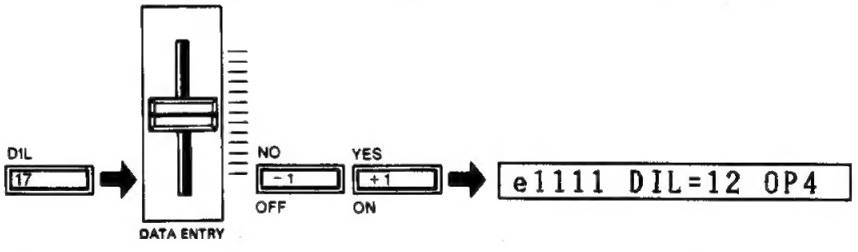
Note that in ALGORITHM 8, the feedback is applied to OP4. If you play a note at this point, you'll notice that the voice still sounds a little dull, and that the high pitch produced by OP4 with feedback is a bit too loud in the high keyboard range. We'll eliminate these problems in the next two steps.

STEP 5: REFINE THE ENVELOPE GENERATOR SETTING

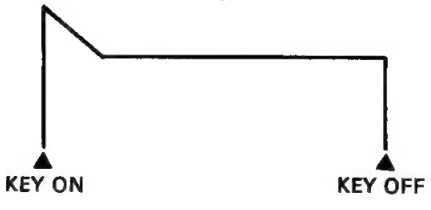
a. Press the ENVELOPE GENERATOR D1R button, select OP4, and set it to 13.



b. Press the ENVELOPE GENERATOR D1L button and set it to 12.



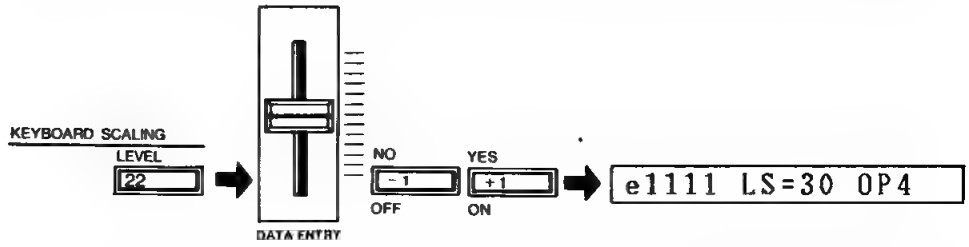
We have just modified the volume envelope of OP4 so that it looks something like this:



This gives a slight percussive attack to the voice.

STEP 6: SET THE KEYBOARD SCALING

Press the KEYBOARD SCALING LEVEL button, select OP4 and set it to 30.



The level of OP4 will now decrease as we play higher notes on the keyboard. This will give a much more natural voice balance over the entire keyboard range.

STEP 7: SET THE LFO PARAMETERS

a. Press the LFO WAVE button and make sure that "triangle" is selected.

```
e1111 LW=triangl
```

b. Press the LFO SPEED button and set it to 30.

```
e1111 LFS=30
```

c. Press the LFO DELAY button and set it to 32.

```
e1111 LFD=32
```

d. Press the LFO PMD button and set it to 10.

```
e1111 PMD=10
```

Now if you play the keyboard, you should get a gentle vibrato effect (pitch modulation) which comes in gradually after a note is played. The gradual application of the vibrato effect is produced by the setting of the LFO DELAY parameter. The higher the setting, the longer the delay.

VOICE 2: ELECTRIC LUTE

This rather fanciful instrument voice takes advantage of the FM tone generator's remarkable ability to accurately simulate plucked string sounds. This voice makes full use of FM modulation, by using ALGOTITHM 2, which provides two levels of modulation as well as the additional modulation of the 1st modulator (OP2) by 2 more modulators (OP3 and OP4).

DATA NAME : ELEC. LUTE

DATE :

NUMBER :

PROGRAMMER :

ALGORITHM	FEEDBACK	LFO WAVE	LFO SPEED	LFO DELAY	LFO PMD	LFO AMD	LFO SYNC	MODULATION SENSITIVITY PITCH	MODULATION SENSITIVITY AMPLITUDE	MODULATION SENSITIVITY EG BIAS	KEY VELOCITY
2	0	triangl	30	0	0	0	off	5	0		
1	2	3	4	5	6	7	8	9	10	11	12

OP	AME			
4	0	0	0	4
3	0	0	0	3
2	0	0	0	2
1	0	0	0	1

OP	FREQ RATIO	DETUNE	AR	D1R	D1L	D2R	RR	OUT LEVEL	RATE	LEVEL	TRANSPOSE
	OSCILLATOR		ENVELOPE GENERATOR					OPERATOR	KEYBOARD SCALING		
4	1.00	0	31	10	10	9	5	76	0	30	C3
3	2.00	0	31	10	10	9	5	57	0	0	
2	1.00	0	31	10	10	9	5	69	0	0	
1	1.00	0	31	10	10	9	5	90	0	0	
	13	14	15	16	17	18	19	20	21	22	23	24

POLY/MONO	PITCH BEND RANGE	PORTAMENTO MODE	PORTAMENTO TIME	FOOT SW ASSIGN	WHEEL RANGE PITCH	WHEEL RANGE AMPLITUDE	BREATH RANGE PITCH	BREATH RANGE AMPLITUDE	BREATH RANGE PITCH BIAS	BREATH RANGE EG BIAS
Poly	2	Full T. Porta	0	Sus	50	0	0	0	50	0

Note that in this voice, the EG settings are the same for each operator. In this case, start by setting the OP1 EG parameters to their respective values, and then use the EG copy function to copy these parameters to OP2, OP3 and OP4 (the EG COPY function also copies the keyboard rate and level scaling parameters). This saves a lot of programming time and effort.

The OP4 KEYBOARD SCALING LEVEL setting of 30 reduces the "bite" of the voice in the high range, producing a more mellow plucked- string type sound over the entire range of the keyboard.

Since it is better to use a subtle vibrato effect for this type of voice, the MODULATION SENSITIVITY, PITCH is set to 5 and the FUNCTION mode WHEEL RANGE, PITCH parameter is set to 50. With these settings, rotating the Modulation Wheel to its maximum position will produce just the right amount of vibrato to enhance the voice.

VOICE 3:
BACKING BRASS

This is a relatively "thick" brass voice which is ideal for a "horn section" background. ALGORITHM 3 is used, but OP3 is left turned OFF (its output level is set to 0). Thus we use the carrier, OP1, modulated by 2 modulators (OP2 and OP4). The feedback loop on OP4 gives us the characteristic "edge" of the brass sound. To see what we mean, try setting the FEEDBACK to 0 and playing the voice. We think you'll agree that the maximum feedback setting of 7 produces the most brass-like sound.

DATA NAME : BACK BRASS

DATE :

NUMBER :

PROGRAMMER :

										AME			OP
3	7	triangl	30	0	0	0	off	5	0	0	0	0	4
										0	0	0	3
										0	0	0	2
										0	0	0	1
ALGORITHM	FEEDBACK	WAVE	SPEED	DELAY	PMD	AMD	SYNC	PITCH	AMPLITUDE	EG BIAS		KEY VELOCITY	
		LFO						MODULATION SENSITIVITY					
1	2	3	4	5	6	7	8	9	10	11		12	

OP												
4	1.00	0	13	31	15	0	8	67	0	0		
3	1.00	0	31	31	15	0	15	0	0	0		
2	1.00	0	13	14	0	0	15	71	0	0	C2	
1	1.00	0	15	31	15	0	8	90	0	0		
	FREQ RATIO	DETUNE	AR	D1R	D1L	D2R	RR	OUT LEVEL	RATE	LEVEL	TRANSPOSE	
	OSCILLATOR		ENVELOPE GENERATOR					OPERATOR	KEYBOARD SCALING			
	13	14	15	16	17	18	19	20	21	22	23	24

POLY/MONO	PITCH BEND RANGE	PORTAMENTO MODE	PORTAMENTO TIME	FOOT SW ASSIGN	WHEEL RANGE PITCH	WHEEL RANGE AMPLITUDE	BREATH RANGE PITCH	BREATH RANGE AMPLITUDE	BREATH RANGE PITCH BIAS	BREATH RANGE EG BIAS
Poly	7	Full T Porta	0	Sus	50	0	0	0	50	0

Note that in this case, the TRANSPOSE parameter is set to C2. This effectively lowers the overall pitch of the keyboard by one octave. This is done to provide a more useful brass range—from low tuba-like tones up to a realistic trumpet range—without having any unnatural "squeaky" tones at the top end of the keyboard.

Vibrato is virtually essential to the production of a realistic brass sound. In this case, the MODULATION SENSITIVITY, PITCH parameter is set to 5 and the FUNCTION mode WHEEL RANGE, PITCH is set to 50. This will allow a fairly deep vibrato to be achieved with the Modulation Wheel. You might like to experiment by adding a subtle automatic delay vibrato using the LFO PMD and DELAY parameters.

The PITCH BEND RANGE is set to 7, giving you a pitch bend range of a fifth, up or down.

Since the D2R EG parameter is set to 0 for all operators, pressing the sustain footswitch will hold all notes played until the pedal is released. This is great for effects such as adding one brass note at a time to form a complete chord.

VOICE 4: FM BELLS

This rather metallic voice effectively demonstrates how fractional modulator-to-carrier frequency ratios can create interesting bell-like sounds. We'll use ALGORITHM 6, in which OP4 simultaneously modulates the carriers OP1, OP2 and OP3.

DATA NAME : *FM BELLS*

DATE :

NUMBER :

PROGRAMMER :

ALGORITHM	FEEDBACK	LFO WAVE	LFO SPEED	LFO DELAY	LFO PMD	LFO AMD	LFO SYNC	MODULATION SENSITIVITY PITCH	MODULATION SENSITIVITY AMPLITUDE	AME	MODULATION SENSITIVITY EG BIAS	KEY VELOCITY	OP
6	0	triangl	35	0	0	0	off	6	0	0	0	0	4
										0	0	0	3
										0	0	0	2
										0	0	0	1
1	2	3	4	5	6	7	8	9	10	11	12		

OP	OSCILLATOR FREQ RATIO	OSCILLATOR DETUNE	ENVELOPE GENERATOR AR	ENVELOPE GENERATOR D1R	ENVELOPE GENERATOR D1L	ENVELOPE GENERATOR D2R	ENVELOPE GENERATOR RR	OPERATOR OUT LEVEL	KEYBOARD SCALING RATE	KEYBOARD SCALING LEVEL	TRANSPOSE
4	5.65	0	31	11	0	0	6	68	0	0	C4
3	0.50	0	31	11	0	0	6	90	0	0	
2	1.00	0	31	11	0	0	6	90	0	0	
1	2.00	0	31	11	0	0	6	90	0	0	
	13	14	15	16	17	18	19	20	21	22	23	24

POLY/MONO	PITCH BEND RANGE	PORTAMENTO MODE	PORTAMENTO TIME	FOOT SW ASSIGN	WHEEL RANGE PITCH	WHEEL RANGE AMPLITUDE	BREATH RANGE PITCH	BREATH RANGE AMPLITUDE	BREATH RANGE PITCH BIAS	BREATH RANGE EG BIAS
Poly	4	Full T. Porta	0	Sus	50	0	0	0	50	0

The basis of this voice is the addition of the outputs from the three carriers. Note that each of the three carriers is set to a different frequency: OP1 to 2.00, OP2 to 1.00, and OP3 to 0.50. Thus, the carriers are all set one octave apart: OP3 is the lowest, OP2 is one octave higher than OP3, and OP1 is one octave higher than OP2. OP 4 is set to the fractional frequency ratio of 5.65 so as to produce a bell-like waveform with each operator, although at a different frequency ratio with each. The result is an extremely complex waveform which is characteristic of metallic bells. You can have some fun with this voice by trying out different fractional values for the OP4 frequency ratio—each will produce a completely different sound.

No vibrato or other effects settings have been provided for FM BELLS because they don't seem to sound "right" with this type of voice. You're free to experiment, of course, so have fun!

VOICE 5:
HARPSI-PIANO

This voice is called HARPSI-PIANO simply because the lower range sounds much like an acoustic piano while the upper range has a more harpsichord-like timbre. ALGORITHM 1 is used with carrier OP1 and all three modulators contributing to the total voice.

DATA NAME : *HARPSI– PNO*

DATE :

NUMBER :

PROGRAMMER :

ALGORITHM	FEEDBACK	LFO WAVE	LFO SPEED	LFO DELAY	LFO PMD	LFO AMD	LFO SYNC	MODULATION SENSITIVITY PITCH	MODULATION SENSITIVITY AMPLITUDE	MODULATION SENSITIVITY EG BIAS	KEY VELOCITY	OP	AME
1	0	triangl	35	0	0	0	off	6	0	0	0	4	0
										0	0	3	0
										0	0	2	0
										0	0	1	0
1	2	3	4	5	6	7	8	9	10	11	12		

OP	FREQ RATIO	DETUNE	AR	D1R	D1L	D2R	RR	OUT LEVEL	RATE	LEVEL	TRANSPOSE
	OSCILLATOR		ENVELOPE GENERATOR					OPERATOR	KEYBOARD SCALING		
4	10.00	0	31	14	0	0	15	64	0	50	C2
3	14.00	0	31	8	0	0	15	59	0	50	
2	1.00	0	31	31	15	0	15	70	0	52	
1	2.00	0	31	10	0	0	15	90	0	0	

POLY/MONO	PITCH BEND RANGE	PORTAMENTO MODE	PORTAMENTO TIME	FOOT SW ASSIGN	WHEEL RANGE PITCH	WHEEL RANGE AMPLITUDE	BREATH RANGE PITCH	BREATH RANGE AMPLITUDE	BREATH RANGE PITCH BIAS	BREATH RANGE EG BIAS
13	14	15	16	17	18	19	20	21	22	23	24
Poly	4	Full T. Porta	0	Sus	50	0	0	0	50	0	

Note the rather extreme frequency ratio settings of OP 3 and OP4. These are critical to the voice. Try changing the frequency ratio of OP3, in particular, and see how much it changes the timbre of the voice. By modifying the frequency ratios of OP3 and OP4 it is possible to create a broad range of interesting and very useful voices.

Also note that the heavy KEYBOARD SCALINGLEVEL is required on OP2, OP3 and OP4 to maintain the quality of the voice across the entire keyboard range. If you reduce these level scaling values, the notes at the top of the keyboard range will become unbearably sharp and tinny.

The TRANSPOSE parameter is set to C2—an octave lower than usual—to take advantage of the fat, rich string effect in the lower keyboard range.

YAMAHA DX27/100 VOICE/FUNCTION DATA

DATA NAME : _____

DATE : _____

NUMBER : _____

PROGRAMMER : _____

										AME			OP
													4
													3
													2
													1
ALGORITHM	FEEDBACK	WAVE	SPEED	DELAY	PMD	AMD	SYNC	PITCH	AMPLITUDE	EG BIAS	KEY VELOCITY		
		LFO						MODULATION SENSITIVITY					
1	2	3	4	5	6	7	8	9	10	11	12		

OP												
4												
3												
2												
1												
FREQ RATIO	DETUNE	AR	D1R	D1L	D2R	RR	OUT LEVEL	RATE	LEVEL	TRANSPOSE		
OSCILLATOR		ENVELOPE GENERATOR					OPERATOR	KEYBOARD SCALING				
13	14	15	16	17	18	19	20	21	22	23	24	

POLY/MONO	PITCH BEND RANGE	PORTAMENTO		FOOT SW ASSIGN	WHEEL RANGE		BREATH RANGE			
		MODE	TIME		PITCH	AMPLITUDE	PITCH	AMPLITUDE	PITCH BIAS	EG BIAS

DATA NAME : _____

DATE : _____

NUMBER : _____

PROGRAMMER : _____

										AME			OP
													4
													3
													2
													1
ALGORITHM	FEEDBACK	WAVE	SPEED	DELAY	PMD	AMD	SYNC	PITCH	AMPLITUDE	EG BIAS	KEY VELOCITY		
		LFO						MODULATION SENSITIVITY					
1	2	3	4	5	6	7	8	9	10	11	12		

OP												
4												
3												
2												
1												
FREQ RATIO	DETUNE	AR	D1R	D1L	D2R	RR	OUT LEVEL	RATE	LEVEL	TRANSPOSE		
OSCILLATOR		ENVELOPE GENERATOR					OPERATOR	KEYBOARD SCALING				
13	14	15	16	17	18	19	20	21	22	23	24	

POLY/MONO	PITCH BEND RANGE	PORTAMENTO		FOOT SW ASSIGN	WHEEL RANGE		BREATH RANGE			
		MODE	TIME		PITCH	AMPLITUDE	PITCH	AMPLITUDE	PITCH BIAS	EG BIAS

DX27/100 DATA NAME

DATE : _____

PROGRAMMER : _____

No.	VOICE NAME	REMARKS
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